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GEOLOGY ENGINEERING ENVIRONMENT HYDROLOGY

May 24, 1990

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DIVISION OF
OIL, GAS & MINING

Mr. Glenn Eurick
Barrick Mercur Gold Mine
P. O. Box 838
Tooele, Utah 84074

Re: Determination of Dump Leach 3 reclamation design percolation potential.

Dear Glenn,

We have completed the reclaimed Dump Leach 3 seepage potential review as you requested. The report comprises this letter.

1.0 Introduction

Barrick has been asked by the Groundwater Section of the Utah Bureau of Water Pollution Control (BWPC) to design a final cover for the proposed Dump Leach 3 that will provide: long-term minimization of infiltration, function with minimal maintenance, and prevent the impoundment of fluids or leachates on the bottom of the dump leach by constructing a final cover with an hydraulic conductivity that is less than or equal to the bottom liners or provide free drainage from the unit so that the liquids that accumulate inside are removed in a timely fashion. Based on these comments and others presented by the BWPC, Barrick asked JBR to assess the potential for seepage through the final cover into the heap interior.

The final configuration of Dump Leach 3 will include 4.2 acres of level area at the top with slopes descending in all directions 180 feet or less at a gradient of 1.5h:1v. The final closure design will include a 6-inch thick clay barrier layer overlain by a three foot thick layer of subsoil and capped with a one-foot thick layer of topsoil for seeding and planting. This three layer cover design will cap the full Dump Leach 3.

JBR has evaluated the seepage potential of the proposed final configuration and design of the Barrick Mercur Dump Leach 3 by performing a water budget analysis of the dump leach system.

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2.0 Method

The Thornwaite/Mather water balance method was used to estimate the depth of water available for percolation at the underlying clay layer (Thornwaite, C. W., and J. R. Mather, 1957 and Fenn et. al., 1975)). The water balance method is based on the relationship between precipitation, runoff, evapotranspiration, soil moisture storage and percolation for groundwater recharge. The precipitation represents that amount of water added to the system while all other factors control the movement of the moisture from the surface wetted by precipitation. The Thornwaite/Mather Method is used by the EPA to evaluate cover system designs for solid and hazardous waste sites (EPA/530/SW-168, EPA-600/2-79-165, and EPA/530/SW-867c).

The factors used in the water balance model were obtained from a variety of sources. Monthly precipitation depths used in this analyses were obtained by averaging five years of monthly precipitation records obtained from the site by Mercur personnel. Runoff depth was estimated using the SCS Curve Number Method assuming vegetative growth on the reclaimed dump leach will be similar to the undisturbed hillsides surrounding the dump. The Curve number used was 73. Potential evapotranspiration estimates were obtained from USGS measured evaporation for the Saltair Salt Plant and for Utah Lake at Lehi. The USGS estimated annual evaporation for Rush Valley to be approximately 50 inches (Hood et al, 1969). Because the Mercur Mine is higher in elevation, a more conservative evaporation estimate of 35 inches was used in this water balance calculation (Lutton, 1980). Monthly evaporation depths for Mercur were estimated using six months of measured evaporation from Utah Lake which were corrected to correspond to the estimated total evaporation depth of 35 inches. For the months in which no data were available (November through April), monthly evaporation estimates were made.

Soil storage was based 3.3 feet of clay loam rather than the designed four feet of soil for two reasons. First, the water balance soil moisture storage parameter required the use of tables to estimate water storage in the soils. These tables were prepared to correspond to every two inches of water. Since a soil moisture table was not available for the seven inches of storage (as estimated for the site), and interpolation between the tables was not a viable option, six inches of potential soil storage was used in the calculations which corresponds to one meter of soil. Second, JBR feels that a conservative estimate on soil depth atop the heap would be of more use than a liberal estimate in the water balance calculations.

3.0 Results

Based on the above data and the assumptions, the estimated total available water for seepage into the clay barrier layer is predicted to be zero after runoff, evapotranspiration, and soil storage depths have been subtracted from total precipitation. A spreadsheet has been included with this letter that lists the assumptions and monthly values used in the water balance calculations. These water balance calculations illustrate that water seepage through the clay barrier layer should not occur because excess water would not be available for seepage.

4.0 Summary and Conclusions

A water balance calculation was made on the reclamation design for dump leach 3 using the Thornwaite/Mather Method. The results of these calculations determined that water will not be available for seepage through the base of the soil cap given an average precipitation year.

The reclamation design should include erosion control features to protect the integrity of the dump surface cap for many years following reclamation. The other potential process by which seepage could occur is by ponding of water on the dump surface. The reclamation design should assure ponding would not occur above the clay cap.

5.0 References

Fenn, D. G., K. J. Hanley, and T. V. Degeare, 1975, Use of the Water Balance Method for Predicting Leachate Generation from Solid Waste Disposal Sites. US EPA SW-168.

Hood, J. W., D. Price, and K. M. Waddell, 1969. Hydrologic Reconnaissance of Rush Valley, Tooele County, Utah Technical Publication #23.

Lutton, R. J., 1980, Evaluating Cover Systems for Solid and Hazardous Waste, US EPA Municipal Environmental Research Lab. SW-867

Thornwaite, C. W., and J. R. Mather, 1957, Instructions and Tables for Computing Potential Evapotranspiration and the Water Balance. Centerton, N. J. p.185-311. (Drexel Institute of Technology. Laboratory of Technology. Publications in Climatology, v. 10, no. 3).

If you have any questions regarding the calculations or assumptions made to perform the calculations, please call anytime.

Sincerely,

Rick Pole

Rick Pole
Hydrologist

cc. Brian Buck

Barrick Mercur

DL-3 Cover Evaluation

Monthly Water Balance
Thornwaite and Mather Method, 1957
(All numbers in inches)

Month	Precip	Runoff	Infil-tration	Potential Evapotrans-tiration	I - PET*	Sum (-) I-PET*	Soil Storage	Change in Soil Stor	Actual Evapotrans-piration	Percolation
Jan	1.47	0.12	1.35	0.00	1.35		2.85	1.35	0.00	0.00
Feb	1.55	0.15	1.40	0.40	1.00	-2.44	3.85	1.00	0.40	0.00
Mar	1.83	0.25	1.58	1.95	-0.37	-2.81	3.58	-0.27	1.85	0.00
Apr	1.79	0.23	1.56	3.65	-2.09	-4.90	2.56	-1.02	2.58	0.00
May	2.06	0.35	1.71	4.71	-3.00	-7.90	1.50	-1.06	2.77	0.00
June	1.33	0.08	1.25	5.54	-4.29	-12.19	0.71	-0.79	2.04	0.00
July	2.35	0.49	1.86	6.14	-4.28	-16.47	0.35	-0.36	2.22	0.00
Aug.	1.33	0.08	1.25	5.40	-4.15	-20.62	0.16	-0.19	1.44	0.00
Sept.	1.28	0.07	1.21	3.95	-2.74	-23.36	0.12	-0.04	1.25	0.00
Oct	1.51	0.13	1.38	2.31	-0.93	-24.29	0.08	-0.04	1.42	0.00
Nov	1.62	0.17	1.45	0.95	0.50		0.58	0.50	0.95	0.00
Dec	0.93	0.01	0.92	0.00	0.92		1.50	0.92	0.00	0.00
Annual	18.64	2.12	16.93	35.00	-18.07					

* Infiltration minus evapotranspiration
* Summation of the negative infiltration minus evapotranspiration

Note that -2.44 inches under Sum (-) I-PET was calculated using the successive approximation method